

# Highlights of Sandia's Solar Programs



Sandia  
National  
Laboratories

Sandia is a partner in the National Center for Photovoltaics and is funded by the U.S. Department of Energy, Office of Solar Energy Technologies.

WORLD WIDE WEB  
<http://www.sandia.gov/pv>

*Since early in the 1980s, Sandia's photovoltaics program (as part of the U. S. Department of Energy's national PV program) has worked collaboratively with many governmental organizations both in the United States and throughout the remainder of the world. Because photovoltaics is an enabling technology that can be easily integrated at remote and rural sites, this partnership has been particularly successful not only with the National Park Service, the Department of Defense, the USDA Forest Service, and the Bureau of Land Management, but also with American Indian tribes.*

*Much of Indian Country includes rural and remote residences and agricultural settings especially well suited to photovoltaics. Sandia began to assist tribes in their use of renewable energy technologies, especially in the Southwestern regions of the U.S., about 20 years ago. Part of the underlying premise of Sandia's work with Indian tribes is the knowledge that it is in the best interest of this Nation to help tribes develop all of their resources, for this benefits not only Indian people, but all people of the United States. Working with just a few tribes initially, we conducted feasibility studies and provided design assistance for off-grid homes and water pumping installations.*

*Through Sandia's Photovoltaic Design Assistance Center, Sandia's Native American work continues today in the form of electrician and installer workshops; in community end-user training sessions; in overall assessments of how renewable energy (particularly PV) can meet the needs of tribes; and in technical design reviews and assistance with procurements. Moreover, Sandia National Laboratories signed a Memorandum of Understanding with the Navajo Nation. This MOU will facilitate an even greater degree of collaboration with the Navajo Nation, and has paved the way for formalizing Sandia's technical work with other tribes.*

*In addition to this ongoing technical work with tribes, Sandia set out in FY01 to identify those PV installations throughout the U.S. on Indian lands that had been successful in helping tribes achieve some of their goals: taking care of the earth, taking care of their people, living as sovereign people, becoming stronger economically, and using their resources wisely. We discovered that significant PV installations exist on Indian lands. Some of these installations were made possible with direct U.S. Department of Energy funding and some were the result of numerous governmental programs, such as the U.S. Public Health - Indian Health Service.*

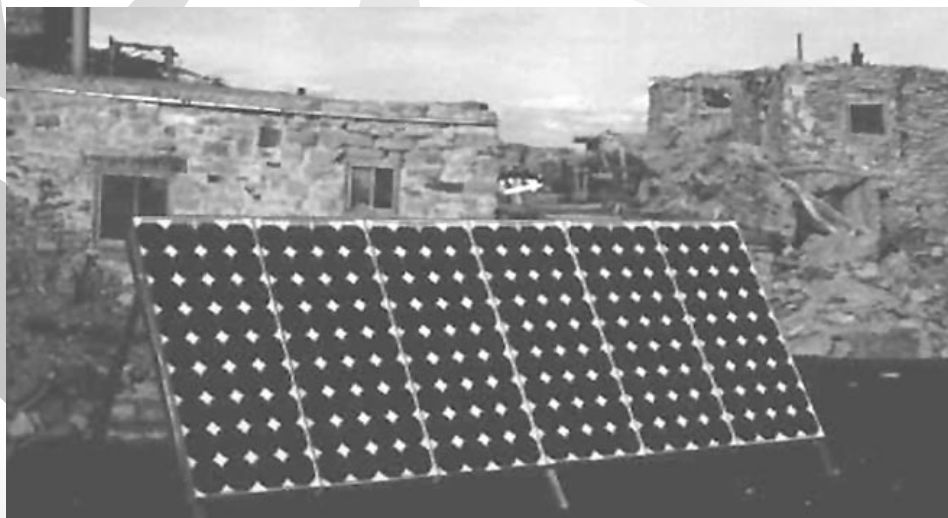
*This Quarterly discusses, historically, Sandia's work with American Indian tribes, describes some ongoing work – including a discussion of **The Solar Way: Photovoltaics on Indian Lands** – the culmination of our search for the most successful applications where PV has made a difference in the lives of Native Americans. All of the photographs included in this Quarterly are taken from **The Solar Way**.*

*Finally, this Quarterly suggests ways in which future work with tribes might unfold.*

## Sandia's Photovoltaics Program

The PV program at Sandia has been one of consistent support, with an emphasis on technical guidance and education on the use of renewables so that tribal leaders can make informed decisions. In certain instances, Sandia has also helped with the development of business plans and actual implementation of projects. Experience from these activities is the basis for the current photovoltaics program at Sandia. The result is a much expanded Lab effort within American Indian communities.

The PV activity will continue to emphasize design reviews, hardware and systems evaluation, feasibility assessments, and trouble shooting of fielded systems, in addition to helping evaluate business opportunities and enhancing access to financial assistance.



**A Village for All Times.** Old Oraibi, a Hopi village on Second Mesa, Arizona, is the oldest continuously inhabited community in North America. It is also one of a handful of Hopi villages that wish to preserve their autonomy and sovereignty without public power lines. PV provides modern amenities to villagers at Old Oraibi without compromising Hopi tradition.



## *The Design Assistance Center*

The Design Assistance Center (DAC) was established at Sandia in 1984 with DOE support. Since that time, the DAC has provided technical assistance on renewable energy uses and power system implementation to well over 150 government agencies (federal, tribal, state, and municipal), utility companies, and private businesses, especially those involved in commercial and residential buildings. This customer support complements the other foci of the National PV Program and the U. S. photovoltaics industry, such as collector and other component development and performance improvements, by accelerating the adoption of the technologies and ultimately reducing the costs.

A natural consequence of these customer interactions is to provide well qualified customer feedback to the industry and government programs. In 2001, for example, the major emphasis of the work at Sandia was the development of improved reliability of PV systems and components. Without access to the performance of and customer satisfaction with PV products, neither the reliability nor needed improvements could be quantified. Thus the DAC has established a needed feedback loop for the continual improvement of this relatively new technology.

Lastly, the DAC interactions place emphasis on the value to the customer. Homeowners, businesses, commercial developers, and power producers all have economic, aesthetic, philosophic, performance, and reliability interests that affect renewables – the purchase of them and subsequent satisfaction with them. A significant portion of customer satisfaction comes through ease of purchase and finance, installation, and after-sales service. All of these customer attributes require a well-informed user community. The DAC has provided hundreds of technical and user workshops throughout the world. The PV website at Sandia receives tens of thousands of inquiries per year, and the DAC distributed more than 15,000 reports and other documents on PV in the past year alone.

Establishment of businesses that can provide these types of services has been especially important in developing countries and communities. As an added benefit, however, this provides additional employment opportunities and generally helps in improving the local infrastructure. Providing information on renewables through informal discussions, formal education programs, workshops, reports, and direct assistance with projects places the DAC staff in a unique position to understand and evaluate the renewable technologies' ability to meet those values. One example is the 60-page report and analysis completed for the Yurok Tribe of Northern California. In collaboration with tribal members, we step through a decision tree process for considering energy options, whether they be renewable energy or more traditional energy.



**PV for Economic Enterprise.** *The Bad River Reservation in northwestern Wisconsin is the largest Chippewa reservation in the state. For more than a quarter-century, the tribe's fish hatchery has restocked millions of walleye into the Bad River system. The PV/wind hybrid system powers the activities of the hatchery and produces a significant portion of its electrical consumption during the year.*



## Working with American Indian Communities

There are more than 500 tribes of American Indians and Alaskan Natives in the United States. Common among these First Americans are traditional and cultural values that include

*Caring for the earth and the people on it,  
Caring about future generations, and  
Living as sovereign people.*

The Design Assistance Center at Sandia has worked with many of these communities since the mid-1980s because of the synergism between their values and the values associated with renewable energy technologies. However, the DAC work only represents a fraction of the efforts by the communities themselves. Late in 2000, the DAC began an effort to look throughout the U.S. to see how American Indian communities had successfully used renewables, especially photovoltaics. The effort was designed not only to document what had worked, but to also look at the values associated with successful, sustainable uses that could serve as models for additional work in this country as well as throughout the world. One result of this effort, ***The Solar Way: Photovoltaics on Indian Lands***, was recently published and is now available from the DAC.

***The Solar Way*** documents many diverse uses where photovoltaics has been an enabling technology to improve basic human services, to improve quality of life, as well as to provide new opportunities for education and economic independence (through employment and business development) without damaging the local environment. In many of the rural areas with very low population densities, extending electrical utility service through conventional line extension requires large subsidies. In addition, conventional power distribution does not encourage use of indigenous resources. Even when line extension is provided, it often represents a loss of energy independence and self-reliance, both of which are important traditional values. Various studies have established that on-site PV systems provide significant savings as compared to line extensions for powering remote residences and villages to livestock watering. Not only do the on-site systems represent an economic advantage, but they also uphold and blend with traditional values.

## REPRESENTATIVE DAC ACTIVITIES WITH AMERICAN INDIAN TRIBES

Acoma	• Feasibility of using PV
Campo	• Site visit to discuss PV for economic development
Cochiti	• PV to support fishery oxygenation project
Havasupai	• Survey and evaluation of PV
Hopi	• Technical assistance to Hopi Foundation to initiate NativeSUN Hopi Solar Project • Site electrical subsystem surveys of installed systems
Hualapai	• Survey and evaluation of PV
Laguna	• PV water pumping systems • Technical assistance for Majors Youth Ranch • Report on feasibility of Laguna Industries manufacturing PV modules with Spire • Testing micro-turbine at Sandia's PV laboratory
Lower Brule Sioux	• Surveyed potential applications, report and hands-on guidebook provided
Manzanita	• Site visit to discuss energy economic development
Mohegan	• Feasibility study of PV at resort/casino
Nambe	• Technical assistance/feasibility study of 1MW system • PV for water pumping
Navajo	• Provided PV Demonstration Trailer to Navajo Tribal Utility Authority (NTUA) • Extensive technical assistance for Navajo Housing Authority, Community Development, Water Resources, the NTUA, and several individual Chapters for more than a decade; ongoing • Memorandum of Understanding between the Navajo Nation and Sandia National Laboratories • Extensive training and workshops for Navajo electricians on PV systems • Community-user workshops
Pueblos, Northern	• Briefed eight Northern Pueblos on potential to use PV in a community center
Pueblos, Various	• Technical review of engineering drawings for Indian Pueblo Cultural Center • DAS and educational kiosk installed at Indian Pueblo Cultural Center
Yurok	• Site visits, preliminary designs, and discussions on energy options • Site assessment and feasibility assessment for tribal representatives
Zuni	• Site assessment for PV for farming, home power, and jewelry manufacturing
OTHER	• Assisted DOE in preparing their FY 2001 Tribal Energy Program Plan • Support activities of Center for Resource Management to encourage renewables on Indian lands • Support activities of Council of Energy Resource Tribes (CERT); ongoing • PV in Alaska Workshop, September 2000, Anchorage, Alaska, attended by some Alaska Native villagers • Hosted water pumping workshop for Ute Mountain Utes and Zuni • Site assessments and PV payback studies for Alaska Native Villages of Kwigillingok, Telida, Allakaket and Rampart • Advisory capacity on hardware installation and curriculum development for Southwest Indian Polytechnic Institute and support for DOE's Golden Field Office tribal colleges and universities program



*This greenhouse at the Zuni Pueblo in western New Mexico is part of the Zunis' overall conservation project. The tribe has plans to use PV for powering circulating fans in the greenhouse, so they can reinvigorate the growing of native plants.*



*Summer or winter, PV provides amenities that add to the quality of life in Lime, an Alaska Native Village. For several years the village has been using a 35kW diesel generator, 24 hours a day, 365 days a year. Installation of the large 12kW PV array permits the village to shut off the noisy diesel during solar peak hours. Lime residents often comment on the sustained period of silent power generation that PV allows.*

## ***A Vital Collaboration***

Indian lands contain large reserves of fossil fuels such as oil, gas, and coal. In terms of potential additional renewable generation, such as solar, wind and geothermal resources, Indian lands represent a huge resource and a legitimate argument can be made that these are the places to look toward. In the future these renewable energy resources may be a key to future necessary electrical generation for the entire country.

Transmission and distribution of energy are also extremely important aspects of developing the potential for grid-tied PV and other renewables. The establishment of tribal electric utilities is one way for tribes to increase the economic benefits to themselves and develop their own energy infrastructure. Certainly as more tribes develop their natural resources, especially in the western United States, they will play an increasingly important role extending far beyond their sovereign boundaries.

## ***Today and Tomorrow***

Photovoltaic activities with Indian tribes have not been different from those with any other customers of the PVDAC. Historically, Sandia has focused on three areas:

- Development of partnerships with appropriate organizations
- Communication, familiarization, education, and outreach/communication on renewables and their application
- Direct assistance associated with project implementation, including analysis and feasibility studies regarding costs and performance and after-purchase trouble shooting.



Plans are to continue to provide this type of assistance, but within a much more structured effort. This year, an expanded program is being developed through a Memorandum of Understanding (MOU) among Sandia, the U.S. Department of Energy, and the Navajo Nation. Although this agreement for cooperation is much broader than renewables (it includes education, environmental issues, and other areas, in addition to energy), certainly renewable energy can become an important means for achieving success.

### ***The Navajo Tribal Utility Authority***

The PV program's work with the Navajo Tribal Utility Authority (NTUA), which is installing hundreds of modular residential off-grid power systems in remote areas on the Navajo Nation, especially in northern Arizona, will be a significant part of the newly developing effort. Engineers at Sandia and its partner, the Southwest Region Experiment Station, have been working with NTUA and its primary supplier of existing systems, Kyocera of Scottsdale, Arizona, by providing instructional workshops on installation and maintenance, and assisting with data collection and analysis, especially on operation and maintenance issues. In addition, community/user workshops have been and continue to be co-sponsored by NTUA and Sandia for the benefit of the customers.

Installation of NTUA's most recent acquisition of systems was financed through a loan from another of Sandia's partners, the U.S. Department of Agriculture's Rural Utility Service (RUS). RUS provides loans not only to the NTUA but also to rural cooperatives throughout the U.S. The experiences gained and the potential market benefits from the NTUA installations are therefore leveraged on a much greater scale through the RUS. The cost of conventional line extension is estimated to be \$20,000 - \$25,000 per mile across the remote and rugged Navajo terrain, so the PV acquisitions provide an economical and viable option for Navajo customers.



**Wetlands Management.** *Big Cypress Reservation lies deep in south central Florida, the largest of the five Seminole reservations in the state. Wetlands management and the environmental impacts of runoff associated with development are of paramount interest to the tribe. Using PV, the tribe collects information about rainfall, water levels, and water samples for parameters such as phosphorous. They also use the data to monitor the environmental impacts of cattle ranching and crop fertilization.*

### ***Expanding Tribal Partnerships***

Expanding partnerships to additional tribes is the first step toward a more comprehensive PV program for Sandia. Working with existing tribal utilities and/or the development of new tribal utilities is but one area where Sandia can be of assistance, but we are also pursuing opportunities to be of assistance as other tribal organizations involved with economic development, education, and health to investigate the benefits of renewable energy. These partnerships are highly focused on a government-to-government approach, and are initiated at the request of the tribes.

A memorandum of understanding is one way—a productive way—to formalize relationships among partners. Discussions regarding PV collaborations are already underway with the Laguna, Jemez and Santa Ana Pueblos, as well

as with the Pyramid Lake Paiute of Nevada, the Zuni, Hopi, and several tribes (rancherias) in California. Although this Quarterly is devoted to PV activities, other renewable technologies such as concentrating solar, wind, and geothermal are also being discussed with these same tribes.

There are initiatives and activities beyond those associated with renewable energy that may indirectly benefit from renewables or that may be bolstered by them. For example, former President Clinton announced the intention of providing federal support for expanding telephone and internet service throughout the Navajo Nation. The Gates Foundation is involved with the Navajo Community Development Division to install computer hardware and satellite communication to all of the 110 Chapter Houses of the Navajo Nation (with one Chapter using renewables as

(cont. on page 6)



## NATIVE AMERICANS BRING TRADITIONAL PERSPECTIVES TO TECHNOLOGICAL SOLUTIONS

Sandian Sandra Begay-Campbell, a Navajo Indian whose many relatives spent most of their lives on arid desert tribal lands near Gallup, New Mexico, seizes every opportunity to acquaint Sandians and representatives of U.S. government agencies with the remote tribal reservations. Sandra is an engineer and part of the technical team in the Renewable Energy Program at Sandia. She is also the Program's spokesperson in efforts to encourage renewable energy technologies on Indian lands.

"You can try to describe rural conditions, but what you say doesn't mean much until people see the poor economy and minimal infrastructures for themselves. That opens their eyes," she says. Begay-Campbell draws from her cultural heritage to explain options to her people and other Native Americans and to serve as a cultural interpreter to Sandia. The goal is not to push a particular technology but rather to listen to needs and offer choices, according to Sandra. "It can be difficult for a technical person to understand that despite the presence of all the physical conditions that allow a particular technology to succeed, it still may not be acceptable because the community doesn't want it."

"Photovoltaics is a good option because it is a clean, quiet source of renewable energy that is in harmony with the Native American philosophy of Seven Generations. That philosophy is to care for the earth and the people on it, care about future generations, and live as sovereign people for Seven Generations to come."

The Seven Generations philosophy was the organizing philosophy behind Sandia's latest publication, ***The Solar Way: Photovoltaics on Indian Lands***, for which Begay-Campbell served as a technical and cultural reviewer.



*Ceremonies of the Turtle, Wolf, and Bear Clans are held in the Oneida Nation Long House. Tribal elders desire that this traditional log long house be kept without utility-provided electricity, so lighting is powered by solar energy.*



*Sandra Begay-Campbell, left, and two Navajo electrical technicians, Vircyntia Charley, center, and Melissa Parrish check the batteries on a Navajo Tribal Utility Authority photovoltaic system in the Kayenta District, Arizona.*

additional power). These efforts will further support the development of telemedicine and distance education alternatives, all of which require an expansion of the energy infrastructure. Sandia plans to support the development of the Integrated Native Energy and Technology Systems (INET) through our expertise in systems integration, although there is only one of the Chapters where renewables will provide the primary power.

Improvement in educational services is critical to tribes. The Southwest Indian Polytechnic Institute (SIPI), along with six other tribal colleges (through cooperative agreements with the U.S. Department of Energy), began an effort to integrate renewables into their campuses. Solar heating for dormitories, PV water pumping for the college agricultural programs, data monitoring, and integration of the systems into the curriculum are a few of the objectives for the effort. The installations are being accomplished by a local Indian-owned business, Sacred Power, which will also provide employment opportunities for some of the students. In addition to working with SIPI as a technical consultant, Sandia is working with some of its other tribal partners to increase participation and buy-in.



*The Ute Mountain Utes rely on their Bow and Arrow cattle ranch, a vital economic enterprise for the tribe. Natural groundwater and runoff provide for most of their livestock water needs, but low annual rainfall led them to seek other sources. Now PV powers water pumps at several locations.*

## THE SOUTHWEST TECHNOLOGY DEVELOPMENT INSTITUTE

The Southwest Technology Development Institute (SWTDI) at New Mexico State University has been an integral part of the U.S. Department of Energy's national PV program since the early 1980s. In recent years a higher concentration of effort from SWTDI has focused on activities in Indian country, including feasibility studies, electrician and customer workshops, operation and performance data collection, resource assessments, and development of maintenance protocols. As such, SWTDI is critical not only to the success of the DAC, but to the success of American Indian projects. Staff at SWTDI helped create *The Solar Way*.



*In 1993, television translator K48EG went on-air, providing public television service to the Flathead Indian Reservation and some outlying areas of western Montana. When the local power company wanted more than \$50,000 to extend electricity to enlarge the service area, the Salish Kootenai College (a tribal college) chose to install a solar system that was only slightly over half the total cost of conventional power.*



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#### PHOTOVOLTAIC SYSTEMS

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*The American Indian Program at Sandia is a work in progress. Every effort is being made to develop a continuing, sustainable program that benefits the Indian community and expands market opportunities for renewable technology.*

*Please do not hesitate to provide suggestions or potential partnership opportunities to the Native American Program Manager,  
Sandra Begay-Campbell, [skbegay@sandia.gov](mailto:skbegay@sandia.gov)  
(505) 844-5418*

*or call*

*Sandia's Photovoltaic Design Assistance Center at  
(505) 844-3698 or (505) 844-4383  
or e-mail the DAC: [pvsac@sandia.gov](mailto:pvsac@sandia.gov).*

*To learn more about photovoltaics, partnerships with American Indians, and the U.S. Department of Energy's National Solar Program, please visit the following websites:*

[www.energy.gov](http://www.energy.gov)

[www.sandia.gov/pv](http://www.sandia.gov/pv)

[www.nrel.gov](http://www.nrel.gov)

**Sandia creates and distributes a variety of publications on photovoltaic systems and their applications. For a list of these documents, please contact the Photovoltaic Systems Assistance Center:**

**through e-mail:** [pvsac@sandia.gov](mailto:pvsac@sandia.gov)

**by phone:** 505-844-3698

**by FAX:** 505-844-6541

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